



Sciaenid species diversity and associated gears at in Hooghly-Matlah Estuary of West Bengal, India

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Abstract

Sciaenids popularly known as croakers constitute an important commercial fishery in the state of West Bengal and rank as the third-largest in catch abundance at Hooghly-Matlah estuarine system. The landings of sciaenids contributed to 11.45% of marine fish catch of West Bengal during the year 2015-16. The present study was conducted to know the status and means of exploitation of sciaenids fishery for a period of one year (March 2017 to February 2018). Out of 20 species recorded genus *Johnius* dominated the group with 6 species followed by *Nibea* (3 species), *Otolithoides* (2 species) and other genera contributed one species each. The most dominant species in the region were recorded as *Otolithoides pama*, *Chrysochir aureus*, *Johnius carutta*, *Panna microdon* and *Johnius gangeticus*. Bag net and drift gillnet were found to be the most commonly used gears to catch sciaenids along with other species. Bholger, a small mesh selective drift gill net was mainly used to catch sciaenids (especially *O. pama*) from the estuarine region. The croakers are also caught by small and large seines, trawls, set-barrier nets, cast nets, lift nets, traps, hooks and lines, etc. The results of the present investigation will provide baseline information on sciaenid's fishery with the means of exploitation from Hooghly-Matlah Estuary.

Keywords: *Sciaenids fishery, croakers, fishing methods, species diversity, gears*

Introduction

West Bengal is a maritime state with a coastline of 158 km, 3, 80, 138 marine fishermen populations. The state contributed 7.49% of total marine production during the year 2016-17 (Bhakta *et al.*, 2020a). The total open water resources of the state are 4.22 lakh ha and estuarine areas contributed about 1.50 lakh ha (Anon, 2017; Bhakta *et al.*, 2020b & 2021). The Hooghly-Matlah estuarine system on the Indian coast of the Bay of Bengal is one of the largest and most productive estuaries in the country (Jhingran and Ghosh, 1978; Bhakta *et al.*, 2019a and 2020a). It covers a distance of about 295 km from the sea face and is located between latitude 21°31' to 23°30' N and longitude 87°45' to 88°45' E changes in fish diversity in different regions. More than 90% of fish caught from the estuary comes from the high saline zone (Mitra *et al.*, 1987).

Mogalekar *et al.* (2017) recognized 267 freshwater fish species from West Bengal and Kar *et al.* (2017) reported 314 fish species from marine habitats. A total of 172 species of fishes are reported from the estuary, of which 73 occupy the freshwater zone and 99, the higher saline zone (Ayyappan *et al.*, 2011). Based on the report of Talwar (1995), sciaenid fishes are represented by 49 species, belonging to 22 genera, in the Indian Ocean of which 40 species belonging to 20 genera, inhabit the different seas along

the Indian coast. The dominant species of West Bengal comprised of *Daysciaena albida* (Cuvier, 1830), *Johnius dussumieri* (Cuvier, 1830), *Johnius belangerii* (Cuvier, 1830), *Johnius carutta* Bloch, 1793, *Johnius coitor* (Hamilton, 1822), *Johnius gangeticus* Talwar, 1991, *Macropsinosa cuja* (Hamilton, 1822), *Otolithoides biauritus* (Cantor, 1849), *Otolithoides pama* (Hamilton, 1822) and *Protonibea diacanthus* (Lecepede, 1802) (Talwar and Jhingran, 1991). The total marine fish catch of West Bengal during the year 2015-16 was estimated at 1,73,771 t and sciaenids contributed 11.45% (Anon, 2017). These fish species are mainly caught by bag net and drift gill net at Hooghly-Matlah estuarine system. In addition other gears used for its fishery are small and large seines, trawls, set-barrier nets, cast nets, lift nets, traps, hooks and lines, etc.

Knowledge of fishing gear and fishing methods is essential for scientific and judicious exploitation including the management of capture fishery (Koleker, 2009; Bhakta *et al.*, 2016 and 2018). Several works have been carried out regarding types of fishing gears used in estuarine waters of India (Pillay and Ghosh 1962; Dutta 1973; De, 1987; Mitra *et al.*, 1987; Koleker, 2009; Remesan *et al.*, 2009; Bhakta *et al.*, 2017). Considerable literature is available on crafts and gears used in Hooghly-Matlah Estuary for catching different species. But the literature on sciaenids fishery resources and their respective means of exploitation is inadequate. So the present study is conducted to bridge the gap.

Material and methods

The present study was conducted at five landing centers of the Hooghly-Matlah estuarine system such as Godakhali, Diamond Harbour, Kakdwip, Namkhana, and Frasergung during March 2017 to February 2018 (Fig. 1). Fishing and fisheries-related activities were found to be the main source of livelihood of the fishers' community of the area. The data on sciaenids fish diversity and their respective means of exploitation were collected by primary and secondary sources (Mitra *et al.*, 1987; Remesan *et al.*, 2009; Kar *et al.*, 2017; Bhakta *et al.*, 2019b). The collected sciaenids species were identified with the help of standard literature/texts (Talwar, 1995; Talwar and Jhingran, 2001; Mohan, 1981 & 1991). The primary data were collected by personal visits to those landing centers wherein 5-10 numbers of fishers were randomly selected from each landing site and after group discussion data were tabulated in the survey sheet. Collected data were properly cross-checked by the experts constituting old fishers and with the secondary source of information (Mitra *et al.*, 1987; Remesan *et al.*, 2009). The secondary data were collected from different reports, bulletins, and articles published from time to time by the competent authority. A survey sheet was made to collect field data on different fishing devices, incorporating the local name, materials used for construction, dimensions, the season of operation, type of species caught, etc.

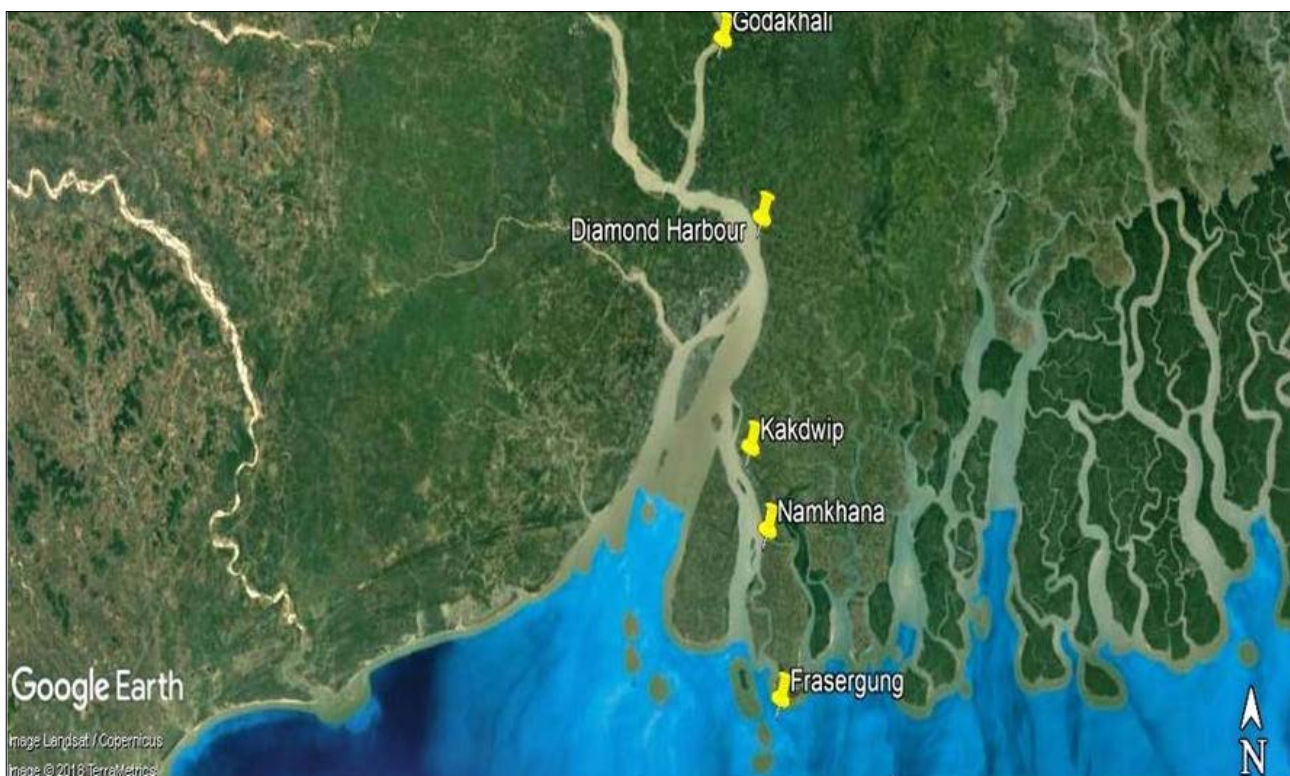


Fig. 1. Study area under Hooghly-Matlah Estuary of West Bengal (photo courtesy: Google earth)

Results and discussion

The sciaenids fish species available at Hooghly-Matlah Estuary in the present study and West Bengal water bodies by other recent reports (Kar *et al.*, 2017) are provided in Table 1 with their respective common name, available local name, and IUCN Red List Status. Out of 20 species recorded genus *Johnius* dominated the group with 6 species followed by *Nibea* (3 species), *Otolithoides* (2 species), and other genera one species each. Species distribution based on salinity gradients found that 10 species fall under both brackish and marine water habitats followed by freshwater, brackish and marine (5 species), marine (3 species), brackish (1 species), and freshwater and brackish water (1 species) (Fig. 2). According to IUCN Red List Status, 17 species fall under Not Evaluated (NE), 2 species as Least Concern (LC), and 1 species as Data Deficient (DD). Types of fishing gears, their local names, operational season, and respective species caught are depicted in Table 2. Bag net along with winter migratory bag net, drift gill net was found most popular and dominant gears to catch croakers along with other species.

Bag net

Bag nets locally called 'been jal', 'behundi jal', 'beenti jal', or 'thor jal' as per their respective sizes and place, and mode of operation (Pillai and Ghosh, 1962). The nets are operated at the bottom and

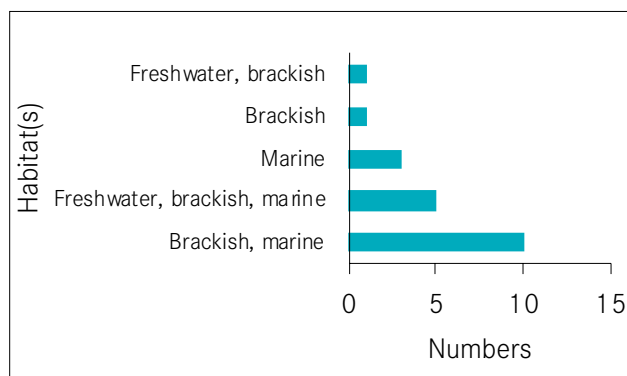


Fig. 2. Habitat-wise distribution of sciaenids species within West Bengal waters

surface water area depending upon the water current and targeted species. The size of the nets varied from place to place and mode of operation. It is a conical-shaped non-selective fishing device with 25-27 m long and 6-7 m wide at the mouth (Pillay and Ghosh, 1962; Manna *et al.*, 2016). The net is made by polyethylene materials with mesh sizes 40-45 mm and 10 mm near the mouth and in the cod-end, respectively (Remesan *et al.*, 2009; Manna *et al.*, 2016). Near the cod-end of the net, a flap is attached to prevent the fishes to escape from the net. The net is operated in the strong current area by two fishermen with a fishing boat. The nets are generally operated for 5-7 hours during the high tidal period and continue as long as sufficient water flows to drive the fishes and prawns into the

Table 1. List of sciaenids species recorded from Hooghly-Matlah Estuary

Name of the species	Common name	Local name	IUCN Red List status	Habitats	Reference
<i>Bahaba chaptis</i> (Hamilton, 1822)	Chaptis bahaba	Bhola	DD	Brackish, Marine	Kar <i>et al.</i> , 2017
<i>Chrysochir aureus</i> (Richardson, 1846)	Reeve's croaker	Madhu Bhola	NE	Marine	Present study
<i>Daysciaena albida</i> (Cuvier, 1830)	Bengal corvina	Surangi Bhola	NE	Brackish, Marine	Present study
<i>Dendrophysa russelii</i> (Cuvier, 1829)	Goatee croaker	Bhola	NE	Freshwater, Brackish, Marine	Present study
<i>Johnius belangerii</i> (Cuvier, 1830)	Belanger's croaker	Bhola	NE	Brackish, Marine	Present study
<i>Johnius borneensis</i> (Bleeker, 1851)	Sharpnose hammer croaker	Bhola	NE	Freshwater, Brackish, Marine	Kar <i>et al.</i> , 2017
<i>Johnius carutta</i> Bloch, 1793	Karut croaker	Lal Bhola	NE	Freshwater, Brackish, Marine	Present study
<i>Johnius coitor</i> (Hamilton, 1822)	Coitor croaker	Kath Bhola	LC	Freshwater, Brackish, Marine	Present study
<i>Johnius dussumieri</i> (Cuvier, 1830)	Sin croaker	Lal Bhola	NE	Brackish, Marine	Present study
<i>Johnius gangeticus</i> Talwar, 1991	Gangetic bola	Lal Bhola	NE	Freshwater, Brackish	Present study
<i>Macropsinosa cuja</i> (Hamilton, 1822)	Cuja bola	Cuja Bola, Kuizza Poa	NE	Brackish	Present study
<i>Nibea coibor</i> (Hamilton, 1822)	Ganges jaw fish	Bhola	NE	Brackish, Marine	Kar <i>et al.</i> , 2017
<i>Nibea maculata</i> (Bloch & Schneider, 1801)	Blotched croaker	Nerey Bhola	NE	Marine	Kar <i>et al.</i> , 2017
<i>Nibea soldado</i> (Lacepede, 1802)	Soldier croaker	Karkat Bhola	NE	Brackish, Marine	Kar <i>et al.</i> , 2017
<i>Otolithes ruber</i> (Bloch & Schneider, 1801)	Tigertooth croaker	Nero Bhola	NE	Brackish, Marine	Present study
<i>Otolithoides biauritus</i> (Cantor, 1849)	Bronze croaker	Nero Bhola	NE	Marine	Present study
<i>Otolithoides pama</i> (Hamilton, 1822)	Pama croaker	Poa Bhola	NE	Freshwater, Brackish, marine	Present study
<i>Panna microdon</i> (Bleeker, 1849)	Panna croaker	Pote Bhola	NE	Brackish, Marine	Present study
<i>Protonibea diacanthus</i> (Lecepede, 1802)	Black spotted croaker	Madhu Bhola	NE	Brackish, Marine	Present study
<i>Pterolithus maculatus</i> (Cuvier, 1830)	Blotched tiger-toothed croaker	Burralli	LC	Brackish, Marine	Kar <i>et al.</i> , 2017

(DD- Data Deficient, NE-Not Evaluated, LC-Least Concern)

Table 2. Name of the gear and fishing season with respective species caught in Hooghly-Matlah Estuary

Gear types	Local name	Season of operation	Species caught (dominant)
Bag net (stationary)	Been jal,	All-season (November-June)	Sciaenids, <i>Setipinna</i> spp., <i>Sillaginopsis panijus</i> , <i>Polynemus paradiseus</i> , <i>Coila</i> spp., small size hilsa, <i>Eutropichthys vacha</i> , prawns, etc.
	Behundi jal,		
	Thor jal		
Winter migratory bag net	Been jal	Late October to early February	<i>Harpadon nehereus</i> , <i>Otolithoides pama</i> , <i>Setipinna</i> spp., <i>Trichiurus</i> spp., prawns, <i>Coila</i> spp., <i>Arius</i> spp., <i>P. paradiseus</i> , <i>Pampus argenteus</i> , <i>Eleutheronema tetradactylum</i> .
Drift gill net	Chandi,	June-March	Mainly hilsa, sciaenids, mullets.
	Dholi,	November-May	
	Kona	Monsoon	
	Bhola ger	All season (except monsoon)	
Hooks and lines	Barsi	All-season	Sciaenids, <i>Pangasius</i> spp., <i>P. paradesius</i> , <i>Rita rita</i> , prawns.
Seine net (large)	Kochal, Jungla	November-February	Hilsa, catfishes, sciaenids, <i>Setipinna</i> spp., <i>P. paradiseus</i> , <i>Coila</i> spp., <i>E. tetradactylum</i> .
Seine net (medium and small)	Ber, Chatber	All-season (except monsoon)	Sciaenids, <i>S. panijus</i> , <i>S. phasa</i> , young hilsa and prawns.
Set-barrier	Char-pata, pata, Charghera	All-season	<i>O. pama</i> , <i>P. pangasius</i> , <i>Liza</i> spp., <i>Labeo catla</i> , <i>Wallago attu</i> , <i>Mystus gulio</i> , prawns.
Lift nets	Seitki, pala	All-season	Prawns and small fishes

(Based on Mitra *et al.*, 1987; Remesan *et al.*, 2009 and present study)

nets. Current-driven fishes and prawns aggregated in the cod-end of the nets, and the harvest was done in each haul. In the estuarine zone, the nets are operated throughout the year with a peak from November to June. There was less or restricted operation observed during monsoon months for the smooth operation of drift gill nets to catch prized hilsa. The species harvested through this net are Sciaenids (mainly *Otolithoides pama*, *Panna microdon*), *Setipinna* spp., *S. panijus*, *Polynemus paradiseus*, *Coila* spp., small size hilsa, *Eutropichthys vacha*, *Eleutheronema tetradactylum*, prawns, etc.

Gillnet

Gillnet locally called 'chandi', 'dholi', or 'kona' is recognized as one of the most popular and common fishing gears. It is a single wall net with a specific mesh size for targeting different species and operated throughout the year. To keep the net in a vertical position float-line and ground-line are attached to the net. The net is set on the surface, mid-water, or bottom, and kept in a stationary position using anchors or weights on both sides of the nets. These nets are of high interest to an artisanal fishery for its low operational cost (Bhakta *et al.*, 2017). The length and size of the nets vary from the season of operation and species caught. The gill nets are active types of nets, highly selective and species-specific. The nets are operated for the targeted species such as *O. pama* and other sciaenids.

Hook and line

It is locally called 'barshi' and mainly used to catch catfishes and other carnivorous fishes by using bait and are operated throughout the year. The cost of the 'barshi' depends upon the number of hooks fixed to the ropes and its length. Hooks and lines are mainly

operated to catch *O. pama*, *Pangasius* spp., *P. paradesius*, *Rita rita*, prawns (mainly *Macrobrachium rosenbergii*), etc. The bottom long line is popular in the lower stretch of the Hooghly-Matlah estuarine system and around 2000 hooks are set per boat with small trash fish such as *Boleophthalmus* spp., *Metapenaeus* spp. etc. as bait collected from 'Behundi jal' catches.

Set-barrier nets

Set-barrier nets locally called 'charpata jal' or 'charghera jal' mainly operated shallow waters during low tides. The net is about 3-4 m wide with several meters long and is made up of fine-mesh (0 to 5 mm). The net is fixed during low tides with a series of poles and fishes during high tides and fishermen collect the fishes from inside the nets. The main species caught by such types of nets are *O. pama*, *P. pangasius*, *S. phasa*, *S. panijus*, *Sperata aor*, mullets, *Labeo catla*, *Wallago attu*, *Mystus gulio*, prawns, etc.

Lift nets

The lift nets locally are called 'basal jal', 'seitki', or 'pala' depending upon the size and mode of operation. The net is triangular with 8 mm mesh size on all sides. The nets are mainly operated to catch prawns and other small fishes along with sciaenids.

There are 39 species under the family Sciaenidae distributed in Indian waters (Froese and Pauly, 2018). The availability of Panna croaker, *Panna microdon* (Bleeker, 1849) from Indian waters, is not mentioned in their list. But in the present study, Panna croaker was found as a dominant species in the region.

The bag net is considered to be the main fishing gear in Hooghly-Matlah estuarine system and contributing more than 70% of the total annual fish catch (Mitra *et al.*, 1987; Paul, 1997; Mitra, 2001; Mukhopadhyay, 2007; Talwar, 2013). There are several reports on the operation of stationary fixed bag net (Jones, 1959; Pillai and Ghosh, 1962; Remesan *et al.*, 2009) and winter migratory bag net (Dutta, 1973; Mitra *et al.*, 1987; Saigal *et al.*, 1989; Talwar *et al.*, 2013; Manna *et al.*, 2016) from the Hooghly-Matlah estuarine system.

The winter bag net catch composition is mainly comprised of small-size fishes and the dominant species or groups are *H. nehereus*, *O. pama*, *Setipinna* spp., *Trichiurus* spp., prawns, *Coilia* spp., *Arius* spp., *P. paradiseus*, *P. argenteus*, *E. tetradactylum*, etc. However, species like *Secutor insidiator* and sardines have increased drastically in the bag net catch composition in recent years (ICAR-CIFRI, Annual Report, 2017). According to De (1987), there were 4000 bag net operating in the Hooghly river and contributed more than 60% of the total fish landings of the system. Mitra *et al.* (1997) reported that *O. pama* contributed 5.2 to 15.9% of the total estuarine catch and 74 to 91% catch comes from the lower estuarine zone and of that more than 95% of the landings was caught by bag net only. Sinha *et al.* (1998) mentioned that bag net, gill net, seines and long lines are the most important gears of Hooghly-Matlah Estuary and bag net contributed 72-75% of the total estuarine catch.

Talwar *et al.* (2013) in their studies mentioned that fin fishes dominated the catch composition (56.06%) followed by by-catch (26.01%) and shellfishes (17.93%) with an average CPUE of 96.09 kg/bag/haul from artisanal estuarine winter migratory bag net from Hooghly-Matlah Estuary. Among the fin fishes most dominant species were *H. neherus*, *O. pama*, *P. paradiseus*, *Ilisha megaloptera*, *S. panijius*, *Trichiurus* spp., etc. and among shellfishes *Metapenaeus* spp. and *Peneaus* spp. (marine form) and *Macrobrachum lamerri* and *M. mirabile* (freshwater form).

There are two types of set bagnet (behundi jal) that operates in estuaries and open seas of West Bengal with motorized boats for the bigger one and non-motorized traditional boats for the smaller one (BOBP, 1990). The bigger one fixed at water depths of around 20 m and the smaller bagnet in near shore with the cod-end mesh size varied from 12 to 6 mm for bigger and smaller net, respectively. Fishes like ribbon fish, Bombay duck, and small clupeids dominated the catch, which is consumed as fresh, sundried, and used as fish meal.

Operation of gill nets was observed throughout the year with predominant species in surface drift gill nets reported as *Tenualosa ilisha*, catfishes, anchovies, gobies, threadfins and major carps (Remesan *et al.*, 2009). Dholi jal also called as

hilsa gill net is mainly used during winter seasons for catching only migratory hilsa shad. The bottom set gillnet is used to catch *Lates calcarifer*, polynemids, pomfrets, threadfins, and catfishes in the lower zone of the estuary (De, 1987). Gillnet was found very popular and prominent fishing gears in other water bodies such as Mandovi Estuary (Kolekar, 2009), Krishna Estuary (Shrivastava *et al.*, 2009), Ukai Reservoir under the Tapti River (Bhakta *et al.*, 2016), Narmada Estuary (Bhakta *et al.*, 2017), Ramganga River (Das *et al.*, 2020) etc.

For catching hilsa in West Bengal waters drift gill nets with 17-125 mm mesh are deployed and the average size of each piece of net is 100 × 200 meshes and a single boat carried 200-400 such net piece (BOBP, 1990). Bhakta *et al.* (2017) mentioned that the gill net is the most popular fishing device of the Narmada Estuary and is mainly used to catch hilsa, sciaenids, mullets, etc. Mitra *et al.* (2001) in their study mentioned that, 'Bhola ber' a highly selective drift gill net introduced during 1998-1999 in the Hooghly-Matlah estuarine system to catch species like 'bhola' (sciaenids) and a total of 377.3 t of catch observed in such nets during 1999-2000 from the estuarine region. Sinha *et al.* (1998) reported that about 22 to 25% of the total estuarine catch comes from gill nets.

Set-barrier or screen barrier is a long wall fixed net and extensively used in backwaters of Malabar (Mohan Rajan, 1983; Remesan and Ramachandran, 2008), in Hooghly Estuary (Jones, 1959; Remesan *et al.*, 2009; Bhaumik and Sharma, 2012). The length of the net and mesh size depends upon the operational season and species caught, large seine mainly caught fishes like hilsa, catfishes, and sciaenids and small seine on prawns and other small fishes (Mitra *et al.*, 1987).

BOBP (1990) reported marine small-scale fisheries of West Bengal and gave detailed account on fishing gear, species and season of operation of commercially important fisheries. Croakers are usually caught by drift gillnets during May-October, set bagnet (Behundi) during September-February, bottom long-line (Dhon) during September-February, and by trawl nets during November-February at the estuaries of West Bengal waters. Gill net, trawl net, dol net, and cast nets were found to be the most efficient fishing device to catch sciaenids throughout the year on both the coasts (Bal and Rao, 1990). Trawl net, bottom-set gill net and bag net were found to be the major gears used for croakers in Indian waters (Joseph and Jayaprakash, 2003). In the recent age of motorization, gears like trawl net, pair trawling, boat seine with echo-sounder facilities are highly used to catch the sciaenids fishes in the west coast of India (Dholakia, 2004).

The predominant fishing devices of the Hooghly-Matlah Estuary of West Bengal were found to be the set bagnet and gill net for catching sciaenids along with other fishes.

The introduction of 'Bhola ger' during the late nineties in the estuarine region was found quite appreciable to catch the sciaenids species. There was a gradual decrease in the operation of bag nets, purse seine, cast nets and drift nets in the estuarine region. While setting gill nets, traps, hooks and line and trawl nets operation was found increasing. Trawl nets with motorized boats are gradually replacing the traditional fishing gears which mainly operate by non-mechanized boats. Presently fishermen are using multispecies gear with a wide range of mesh size to catch different sizes of species. Indiscriminate use of small mesh net especially bag net to catch juveniles was found destructive to the stock. Optimum fishing efforts by an increase of mesh size, observing closed season during peak breeding season, are some suitable measures to preserve the stock in the region.

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